#### ASK INDUSTRY EXPERTS

#### DR. ROBBIE HOOD

#### NOAA UNMANNED AIRCRAFT SYSTEMS PROGRAM DIRECTOR

Atmospheric scientist Dr. Robbie Hood has served as the director of the National Oceanic and Atmospheric Administration's Unmanned Aircraft Systems Program office since 2008. She sat down with Unmanned Systems to give an overview of the program and to highlight changes coming in the near future.

## Q: Tell us a little about yourself, how you came to this position and what your background is.

A: My expertise has been in a lot of weather kinds of experiments, especially things related to hurricanes at sea, tropical weather, thunderstorms, those kinds of things, and as I was working in that field, I always realized that what we were trying to do was learn more about the weather phenomenon, and part of that is trying to get inside the storm to see what's happening. It's been about 15 years now or more, I started thinking, wouldn't it be easier to have an unmanned system to do this to make it safer to the scientist to try and collect data?

Unmanned aircraft systems have always been intriguing to me, both from the standpoint of reducing danger for the scientist, but also the aspect of being able to sit in one place and look at data together at the same time.

# Q: Can you talk me through NOAA's family of unmanned aircraft? Do you plan on adding more to that in the future?

A: Within the UAS program, in 2009 we actually looked at the state of UAS technologies across the board and tried to match up where we thought the technologies could best fit into the agency and could bring value. And we really looked at the general categories of high alti-

tude, long endurance; medium altitude long endurance; low altitude, long endurance; and then the very small low altitude, small endurance, like VTOLs [vertical takeoff and landings] and fixed-wing devices, and we could really see that there was a need for many of those things that could well serve a purpose.

I think from those categories we've probably focused more recently on the low-altitude, shortendurance ones, because we see those as quick response vehicles that we can take. They're easy to transport, and you can pull them out and use them to improve, whether it's marine monitoring of the national sanctuaries or understanding flood regions, trying to get a better understanding of a regional area, we've focused on those. But also the bigger ones like the Global Hawk, we've been partnering with NASA, but we really seen those as devices we could consider roving satellites. We can really get far out over the oceans and try to collect data there that could help fit into this bigger observing strategy that we have using satellites and other vehicles.

Now we're starting to circle back and say, now let's look at the other, the medium-altitude and the low-altitude, long-endurance ones. How can we use the low-altitude ones from ships to increase our observation coverage with what the ship is doing now?

Our real goal is we're looking at transitioning some kinds of UAS



Dr. Robbie Hood. AUVSI photo.

activities into the agency for operational use, but we're still trying to look also at what's the best mix of platforms and sensors and payloads that we need in the agency.

# Q: What kind of innovations do you think NOAA has made in that realm of sensing and the sensors you decide to put on your unmanned aircraft?

A: NASA has been the leader as far as using the Global Hawk for scientific purposes and scientific research. And they have this hurricane experiment called the Hurricane Severe Storm Sentinel, and they've been flying Global Hawks as part of that for the last three years.

Starting this year, we're going to take some of the Global Hawk data over to NOAA and actually put that into the weather forecast models. We're going to take the dropsonde data, which is an in-situ device that drops from the aircraft and collects temperature, pressure, moisture, and wind speed and direction, and look at how to incorporate those directly into our forecast models. We have done some initial testing, and

we're finding that that instrument by itself, or those measurements by itself, have really strong potential for improving our hurricane forecasts. So we're excited about that this year.

## Q: What can you get with that dropsonde that you're not getting with satellite or what your previous methods were?

A: The way to think of it is, when you collect data from a satellite, it gives you a very wide aerial coverage on the Earth, but sometimes the data resolution is coarser. If you could take similar sensors and put them on an aircraft flying lower to the Earth, it's just like putting it under a microscope. You can have the same kind of data, but you see everything in higher detail. So it's basically the difference between an X-ray and an MRI. There's something you can see in much higher detail with a different kind of technology.

The other thing is the fact that the Global Hawk can carry remote sensors, which is going to be really important, because the other thing we want to look at is, how can we provide better coverage of a weather system by having the remote sensors which are also very similar to the satellite sensors, but can give us continuous data? The dropsondes have a slight disadvantage in the fact that that's a point source. You drop a dropsonde, and you collect data wherever it falls. It's going through the real atmosphere, so it's accurate data, but you drop one and then you drop the other and you have to interpolate between those two to understand the full picture. A remote sensor actually

collects the information across a much broader area.

## Q: Can you talk to me a little about NOAA's UAS operators. Are those all through NOAA Corps?

A: Right now those are NOAA Corps officers, but we are talking about what it would take to — especially with the smaller platforms — what it would take to allow scientists the opportunities to fly. So we're looking at those kinds of procedures internally. But part of is going to be based on what the FAA [Federal Aviation Administration] guidelines do. Ground school certification, does that have to be a requirement? And right now we're treating it that that's what the FAA says and that's what we're going to do.

# Q: I'm imagining in that scenario that you're having some scientists work on missions that are kind of unfamiliar with unmanned aircraft. What has been their experience and what has been their feedback to you on what it's like to work with these new systems?

A: Actually I would say there's quite a bit of excitement. We just finished a deployment there where we actually put a Puma on a ship and we cruised around the Hawaiian islands with our NOAA scientists, and they were looking at monk seals, they were looking at marine debris, they looked at sea turtles, they looked at marine domain awareness, just where our ships are passing through that monument. And the word we're getting back is that the scientists were pretty excited, mainly because

here's a chance instead of a scientist standing stationary on a coast or a shoreline or being on a ship, now they've got something they can send over to a particular region, so it increases the area they can coverage and monitor.

But also with the wildlife, the UAS don't disturb the wildlife. They're pretty quiet. So it's actually, in some cases, it's better than having an observer walk along the shore, because you're providing less disturbance. What we need to work on more is, do we have the best camera systems that we need? The scientists like the concept of operations of UAS, but [what] we're finding is once they have a chance to catch their breath and sit down and think, "What would make this perfect?" what we're hearing is they'd like to see better cameras, higher resolution cameras on the system. So that's one of the key focuses of our program in the next

#### Q: What do you think the value is of focusing on the polar regions for climate assessment work?

A: We partnered with NASA on a marginal ice zone experiment, and that was a summertime experiment to look at how certain areas that had sea ice melting, how fast was the ice melting and trying to understand what's happening in the atmosphere right above that sea ice change. Are there atmospheric changes that are implementing it? NOAA already has another experiment that they're participating in where they're looking at an unmanned marine system and going to the Arctic and looking at observations in the water to look at



A NOAA Corps operator launching a Puma offshore Hawaii on a summer mission to monitor wildlife and marine debris. Photo courtesy NOAA.

ocean acidification, carbon dioxide that's in the atmosphere gets into the ocean, and how the melting glaciers are putting fresh water into the region, how that's impacting everything.

The Arctic in particular, that's an area where there's so much we need to learn there, but it's such a harsh environment that it's a perfect place to use unmanned systems, both water and air.

The U.S. Coast Guard is also looking at unmanned technologies, both water and air. So they are moving toward setting up a cruise of their Healy ice cutter in the summer on an annual basis and inviting other agencies to come and test technologies together. So we're going to treat it like a test bed. So we flew our Puma systems with them last year, and we found it was really effective.

We're going to be working with them with the Pumas again this year and hopefully trying a deck landing for the first time. We're going to see. But what we want to do next year is look, can we bring other systems through a partnership with the Navy or Coast Guard or ourselves, can we bring other systems like the [Insitu] ScanEagles or other longer endurance vehicles? And then also how can we use, say, a fleet of

vehicles with one system that's got a meteorological payload that can look at the boundary layer of the atmosphere right above the sea in concert with another platform that may be carrying more of a remote sensing payload that can do better mapping of the sea ice conditions and maybe the elevation of the sea ice in that area? That's a new concept we're starting to talk about.

I think that's one of the waves of the future is, instead of just having one system with one kind of payload do one kind of mission is now, how would you optimize that observing strategy so you could study the atmosphere, and the sea ice, and photographic the wildlife there — a comprehensive system of platforms that are working together.

### Q: Does NOAA have a tie in to the work ConocoPhillips is doing in the Arctic with the ScanEagle?

A: We don't have a tie in yet, but we're actually talking to them.
We're actually exploring a CRADA [cooperative research and development agreement], which is a private industry-government partnership so that we can share information that ConocoPhillips may be collecting on their own. So, are there ways that, if they're going to fly these

missions, can we make use of the data as well? And then moving forward then, especially learning some of the problems they've had with flying in the Arctic with the systems they've tried to use, trying to learn from those lessons.

# Q: Going into this 2014 season, what are you particularly focused on with Hurricane Severe Storm Sentinel and what are your lessons learned so far?

A: The Hurricane Severe Storm Sentinel is a NASA-led mission, but what we're hoping to do with it is we're hoping to follow behind them and take those lessons learned and say, "How would you apply that to operational weather forecasting?"

Next summer we're hoping we're going to go back out again with the Global Hawk, but it will be a NOAA-led mission. We're calling that experiment Sensing Hazards With Operational Unmanned Technology, or SHOUT.

The emphasis of HS3 has been on improving understanding of hurricane development and genesis and intensity changes. It's a research experiment. The scientists are all focused on getting data to improve their understanding of those processes. What we're going to be stepping in and saying is, well, there are some really good instruments here that can probably help our weather forecast models right now. So let's look at how would we fly missions differently if they were focused on weather forecasting as opposed to research. We might fly in different regions.

The SHOUT experiment is not just hurricanes though. Next year we're focusing on hurricanes, because we're picking up the baton from NASA. But we're also going to be looking at storms in the Pacific,

at sea and in Alaska, so storms that are really far out over the ocean now that we can't quite get to, and can we improve weather forecasting in the three- to seven-day range so we can get a much more accurate forecast than you do now?

#### Q: What do you think the future of unmanned aircraft is at NOAA? How far can it go?

A: My vision is what we're going to be moving toward are they are going to be like baby satellites, those areas where we want routine coverage but we want higher resolution than we can get with a satellite. Hopefully we're going to learn lessons so if you know you can go to the Arctic twice a week for six months out of the year, you're going to have a better understanding, you set those missions up just like a satellite mission. You fly, this aircraft takes off, you fly, you go to the Arctic, you go back and it gets the data. Instead of trying to move the aircraft around so much where the phenomena are. At least with the big ones.

With the smaller ones, I see that they're going to be our rapid response vehicles. So we have an incident, an oil spill or some marine debris or we want to take a closer look at a particular coastline, well, let's bring our smaller vehicles and let the scientists fly them in the area and make it cheap enough that they can do it every day. Instead of trying to charter one aircraft mission a couple of times a year or a ship mission a couple of times a year. You can only do it a few times because it's too expensive. Can we do something more affordable that people can use every day? I see both extremes. Can we make it more affordable so people can use them every day, but also can we make it so routine that we're augmenting our satellite and other observing systems with routine data that we can count on?

